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Atomically controlled, self-limiting procedures for growth of aluminum oxide on SiC-on-Si

Ana G.-Silva[1], Kjeld Pedersen[2], Zheshen Li[3], Per Morgen[4]

[1]Universidade Nova de Lisboa, P-2829-516, Portugal, [2]Aalborg University, DK-9220, Denmark, [3]Aarhus University, DK-8000, Denmark, [4]University of Southern Denmark, DK-5230, Denmark

Electronic devices fabricated from SiC/Si epitaxial wafers will need surface passivation and insulating coatings. For solar cell applications – and in MOS systems – Al-oxide thin film coatings have some strong advocates, not the least due to the advances of the ALD process.

We have grown SiC/Si, formed by a remote CH_4 plasma interacting with Si surfaces in UHV. After growing the SiC/Si system (SiC thickness between 0.5 and 5 nm; polycrystalline) a self-limiting Si-oxide layer was grown on the surface, with a thickness of around 1 nm, at 700^0C. On top of this layer we deposited approximately 1 nm of Al with a Knudsen atomic source (all steps in UHV) and then reacted it thermally (at 600^0C) with the Si-oxide. We monitored all the process steps and the resulting structures of the layers and the interface using synchrotron radiation induced core level photoemission at ASTRID, Aarhus, Denmark. We found similar qualities with this procedure, as for Si, i.e. an atomically sharp interface between Al-oxide and SiC, and this reaction scheme offers self-limiting behavior both of the oxidation to create Si-oxide, and to the conversion into Al-oxide, which only needs a sufficient amount of Al to affect the total conversion of the Si-oxide, while excess Al will leave the system at sufficiently elevated temperatures.